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Accidents and close call situations connected to the use of mobile phones

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ABSTRACT

The aim of our work was to study the accidents and close call situations connected to the use of mobile phones. We have analyzed how the accidents/close call situations are connected to background information, in particular age, gender and self-reported symptoms. The study was carried out as a cross-sectional study by posting the questionnaire to 15,000 working-age Finns. The responses (6121) were analyzed using the logistic regression models. Altogether 13.7% of respondents had close call situations and 2.4% had accidents at leisure, in which the mobile phone had a partial effect, and at work the amounts were 4.5% and 0.4% respectively, during the last 12 months. Essentially, we found that: (1) men tend to have more close calls and accidents while on a mobile phone, (2) younger people tend to have more accidents and close calls while on a mobile phone, but it does not appear to be large enough to warrant intervention, (3) employed people tend to have more problems with mobile phone usage and accidents/close calls, and (4) there was a slight increase in mobile-phone-related accidents/close calls if the respondent also reported sleep disturbances and minor aches and pains. In the future, it is important to take into account and study how symptoms can increase the risk of accidents or close call situations in which a mobile phone has a partial effect.

1. Introduction

According to the "Injuries in the European Union, summary 2003–2005" report, injuries in the EU kill over 250,000 people each year, and injuries are the leading cause of death in children, adolescents and young adults. In the 27 EU countries, the average rate of fatal road traffic accidents is 10 per 100,000 (Angermann et al.

In general, traffic accidents cause about 350 deaths, and domestic accidents and other leisure time accidents cause about 2100 deaths (FAII, 2007; Ministry of social affairs and health, 2003; Statistics Finland, 2006a; The national research institute of Legal Policy, 2003).

In the use of e-communications by households, the mobile phone penetration rate is 80% among EU-25 households. In Scandinavia and the Netherlands the mobile phones penetration is highest (Eurostat, 2007). According the Finnish statistical office (in Finland, 2008): 99% of households have one or more mobile phone (Statistics Finland, 2008). In 2006 the amount of extension of mobile phones was 5,679,010 and in 2001 the amount was 4,137,337 in Finland. The amount of extension has increased 31.8% during the five years (Statistics Finland, 2006b).

Many studies described the effects of mobile phone usage on driving performance (Alm and Nilsson, 1994, 1995; Brookhuis et al., 1991; Eby et al., 2006; McCartt, 2005; Irwin et al., 2000; Lam, 2002; Lamble et al., 1999; McKnight and McKnight, 1993; Strayer and

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mobile phone use and the risk of car collision and injury (McEvoy et al., 2007; Laberge-Nadeau et al., 2003; Redeleier and Tibshirani, 1997; Sagberg, 2001; Violanti and Marshall, 1996). In addition, the age of the driver was included in the analyses (Violanti, 1997, 1998; Lam, 2002). For example, Ulleberg (2002) reported that sensation-seeking characterized a high accident-risk group of young drivers. In addition, researchers have found considerable evidence that, at a young age, differences in the socioeconomic distribution of road-traffic injuries are common among several categories of road users (Laflamme and Diderichsen, 2000; Hasselberg et al., 2001; Laflamme and Engström, 2002; Laflamme et al., 2005; Oltedal and Rundmo, 2006).

According to Strayer et al. (2003), drivers are more likely to miss critical traffic signals, are slower to respond to the signals they do detect, and are more likely to be involved in rear-end collisions when they are conversing on a cell phone. In addition, when the participants directed their gaze at objects in the driving

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environment, they often failed to "see" them when they were talking on a cell phone. In this situation their attention has been directed away from the external environment toward an internal, cognitive context associated with the phone conversation (Strayer et al., 2003, 2006). Strayer et al. (2006) have also concluded that when driving conditions and time on task were controlled for, the impairments associated with using a cell phone while driving could be as profound as those associated with driving while drunk.

Gender has also consistently been reported to be related to risk behaviour (Oltedal and Rundmo, 2006). Yagil (1998) found that male drivers expressed a lower motivation to comply with traffic rules (particularly the younger individuals) and males perceived traffic violations as less dangerous than females did. In addition, Rosenbloom and Wolf (2002) found a risky shift in the detection of danger on the road by males compared to females.

The aim of our work was to study the accidents and close call situations connected to the use of mobile phones. We have analyzed how the accidents/close call situations are connected to background information, in particular age, gender and self-reported symptoms. This work is based on answers from a questionnaire, which included questions about the possible influence of new technical equipment on health, accidents and close call situations.

2. Methods

2.1. Study population

The questionnaire was sent to 15,000 Finns in October 2002. Because the study focused on the working age population the questionnaire was only sent to people between the ages of 18 and 65. Although some of them are already retired, unemployed or still studying, all the answers were taken in account. Names and addresses were obtained as a random sample from the Finnish population Register Centre. This way the study population represents the whole working age population relatively well. Concerning the residence and the socioeconomic status random sampling also gave approximately the same number of men and women. All the answers were handled anonymously and the study design was approved by the Ethical Committee (Pirkanmaa Health District, Finland, decision R02099).

2.2. Questionnaire

The questionnaire was posted with a cover letter. On the first page there was a letter to the participant. In the letter the leader of study explained the study and gave some practical instructions. On the second page there was an example of how to answer the questions. The questionnaire was divided into six sections. The first section dealt with background information such as age, gender, marital status, education, trade and home county (Finland is divided geographically into six counties). In section two the familiarity and use of given technical devices were mapped. People were also asked how important these devices were to them at work and leisure. If a respondent did not have a job at the moment, he or she only answered questions about leisure. In the third section the focus was on physical loading and ergonomics. The section included, e.g., a question: '(13) Have you had an ache, pain or numbness in the following body part during the last twelve months? (a) in wrists and fingers, (b) in elbows and forearms, (c) in neck, (d) in shoulders, (e) in hip an lower back, (f) in feet during the last 12 months?'.

The fourth section concerned psychological welfare. It included, e.g., a question '(16) Have you suffered: (a) sleeping disorders/disturbances, (b) depression, (c) exhaustion at work, (d) substance addiction, (e) anxiety or (f) fear situations during the last 12 months?'. Accidents were handled in the fifth section. The section includes questions: (18) Have you had an accident or accidents at leisure, in which the mobile phone had a partial effect, during the last 12 months?, If the answer is yes, then how?, (a) disturbed concentration while moving, (b) disturbed concentration while driving, (c) disturbed observing the environment, (d) caused the situation, (e) other; (19) Have you had a close call situation or situations at leisure, in which the mobile phone had a partial effect, during the last 12 months? If the answer is yes, then how?, (a) disturbed concentration while moving, (b) disturbed concentration while driving, (c) disturbed observing the environment, (d) caused the situation, (e) other. The next questions (20 and 21) are similar, except they deal with working life. The choices for the questions were: cannot say, not at all, somewhat, fairly noticeable, noticeable, very noticeable, and missing. The last part was an open-ended question 'other observations concerning technology and health'. Also a lottery ticket was attached, which was, however, handled separately from the answers, so privacy was secured. The details of the questionnaire have been reported earlier (Korpinen et al., 2009).

2.3. Statistical analysis

The statistical analyses were done using the PASW Statistics 18 (formerly known SPSS Statistics) and the IBM SPSS Statistics version 19. The options to the question '(13) Have you had an ache, pain or numbness in the following body part during the last twelve months? (a) in wrists and fingers, (b) in elbows and forearms, (c) in neck, (d) in shoulders, (e) in hip and lower back, (f) in feet' was classified so that answers of 'cannot say', 'not at all' and 'sometimes' were coded 0 (no symptoms) and 'pretty often', 'often' and 'very often' were coded 1 (symptoms). In addition, the answers to the question '(16) Have you suffered, (a) sleeping disorders/disturbances, (b) depression, (c) exhaustion at work, (d) substance addiction, (e) anxiety or (f) fear situations during the last 12 months?' were codified in the same way.

In the first analysis we studied the answers to questions 18, 19, 20 and 21 using different groups: gender, age groups (under 30 years old and 30 or over years old), age groups (under 45 years old and 45 or over years old), groups of the respondents with different symptoms (pretty often or more) from questions 13a–f or 16a–f and without symptoms. We used the independent samples Mann–Whitney *U*-test.

In the second analysis, we studied the questions 18, 19, 20 and 21 with different logistic regression models. We tested the models using the Hosmer–Lemeshow goodness-of-fit test. According to Norusis et al. (1999), when the observed significance for the chi-square value is greater than 0.05, we do not reject the null hypothesis, so there is no difference between the observed and predicted values. In this situation, the model fits the data well. However, if the significance is only a little more than 0.05, the model fits fairly well.

3. Results

3.1. Background information

During the winter 2002–2003 a total of 6121 responses arrived. Thus, the response percent was 41. The mean age ± standard deviation (SD) was 41.3 ± 13.1 years. There were 3486 (57%) women and 2625 (43%) men. Note that the study population included the entire "working-age" population and should not be confused with the "working population", as some working-age respondents were not employed. In fact, at the time of the questionnaire was 71% of the respondents were employed. A summary of background information is in Table 1. In Table 1, there are the result from all respondents, women and men. There are also the amount of

Table 1
A summary of background information of all respondents, women and men.

Topics of questions and choices	All	%	Women	%	Men	%
Q3 Marital status						
Single	1343	22.0	747	21.5	594	22.6
Married or live-in	4219	69.0	2356	67.7	1857	70.8
Divorced	449	7.3	294	8.4	154	5.9
Widow or widower	101	1.7	82	2.4	18	0.7
Q5 Education						
Comprehensive school	1075	17.6	567	16.3	506	19.3
Matriculation	654	10.7	443	12.8	209	8.0
Vocational school	1665	27.3	790	22.7	871	33.3
Vocational high school	1879	30.8	1196	34.4	682	26.1
University	828	13.6	478	13.8	349	13.3
Q6 Occupation						
None[a]	49	0.8	21	0.6	28	1.1
Enterpriser	451	7.4	179	5.2	271	10.4
Farmer	194	3.2	103	3.0	91	3.5
Upper-level white-collar workers[b]	1121	18.4	555	16.0	565	21.6
Lower-level white-collar workers[c]	1425	23.4	995	28.6	428	16.4
Blue-collar workers[d]	2122	34.8	1122	32.3	997	38.1
Home work, student	461	7.6	336	9.7	125	4.8
Other	279	4.6	164	4.7	112	4.3
Usage of mobile phone						
(Q11a) usage at work	3146	70.5	1448	59.2	1694	84.4
(Q8a) usage at leisure	5875	96.5	3334	96.1	2532	96.8
Q18 Accident at leisure in which the mobile phone had a partial effect						
No accident at leisure	5735	97.6	3277	97.8	2451	97.3
Accident at leisure	143	2.4	74	2.2	68	2.7
Q19 Close call situation at leisure in which the mobile phone had a partial effect						
No close call situation at leisure	5081	86.3	2936	87.3	2140	85.0
Close call situation at leisure	807	13.7	427	12.7	379	15.0
Q20 Accident at work in which the mobile phone had a partial effect						
No accident at work	5062	99.3	2811	99.6	2244	99.0
Accident at work	34	0.7	11	0.4	23	1.0
Q21 Close call situation at work in which the mobile phone had a partial effect						
No close call situation at work	4823	95.5	2729	97.6	2088	92.9
Close call situation at work	225	4.5	66	2.4	159	7.1

[a] Never had an occupation.
[b] Administrative or managerial duties, designing, research, teaching.
[c] Clerical duties and supervision.
[d] Industrial workers, distributive and service trade.

answers and the percentage value. In the part of the usage of mobile phone, there are the amount of positive answers including answers; 'less than monthly', 'monthly', 'weekly' or 'daily'. From the questions 18, 19, 20 and 21 about accidents and close call situations, there are the amount of only "yes" and "no" answers (Table 1).

In Table 1, 143 (2.4%) of respondents had accidents, in which the mobile phone had a partial effect, at leisure and 34 (0.7%) had accidents, in which the mobile phone had a partial effect, at work during the last 12 months. The women's amount of accidents, in which the mobile phone had a partial effect, 74 (2.2%) at leisure and 11 (0.4%) at work, are lower than the men's amount, 68 (2.7%) at leisure and 23 (1%) at work.

3.2. Results of the Mann–Whitney U-test

Table 2 shows the analyses of the answers to questions 18, 19, 20 and 21 using different groups: gender, age groups (under 30 years old and 30 or over years old), age groups (under 45 years old and 45 or over years old), groups of the respondents with different symptoms (pretty often or more) from questions 13a–f or 16a–f and without symptoms. Comparison between the women's and men's answers (18, 19, 20 and 21) shows the differences are significant in questions 19 (close call situation at leisure in which the mobile phone had a partial effect), 20 (accident at work in which the mobile phone had a partial effect) and 21 (close call situation at work in which the mobile phone had a partial effect). In the statistical analyses of questions 19, 20 and 21 in the men's group, the mean rank values are higher than in the women's group. Hence the men had more close call situations or accidents.

In the comparison between age groups <30 years old and ≥30 years old the differences are significant in questions 18 and 19, and between the age groups <45 years old and ≥45 years old the differences are significant in questions 18, 19, and 21. In both comparisons the mean rank values are higher in the group of younger respondents than in the older respondents' group. Hence the young respondents had more close call situations or accidents. We used two age groups, because the age group <30 years old was quite small. However, we also wanted analyze young persons (<30 years old).

In the comparison of respondents' groups with and without different mental symptoms (Table 2) there are a number of significant differences. In the leisure time questions (18 and 19) there are significant differences between the groups with and without mental symptoms (sleeping disorders/disturbances, depression, exhaustion at work, substance addiction, anxiety, fear situations). In the working life questions (20 and 21) there are significant differences between the groups with and without exhaustion at work (16c), substance addiction (16d), anxiety (16e) and fear situations (16f). In the cases where the differences were significant, the mean rank values are higher in the group with symptoms than in the group without symptoms. So the respondents with mental symptoms reported more accident or close call situation at leisure or at work in which the mobile phone had a partial effect.

Table 2
Comparison between different groups (women/men, under 30 years old/30 and over, under 45 years old/45 and over, respondents with symptoms (questions13a–f, 16a–f)/without symptoms) with an independent samples Mann–Whitney *U*-test analysis for questions 18–21.

Comparison groups with Mann–Whitney *U*-test	Q18 Asymp. Sig. (2-tailed)	Q19 Asymp. Sig. (2-tailed)	Q20 Asymp. Sig. (2-tailed)	Q21 Asymp. Sig. (2-tailed)
Gender (women and men)	0.225	0.010**	0.007**	0.000**
Age (<30 years old and ≥30 years old)	<0.001**	<0.001**	0.374	0.442
Age (<45 years old and ≥45 years old)	<0.001**	<0.001**	0.132	0.008**
Q13 Experienced pain, numbness or aches (respondents with pretty often or more symptoms and without symptoms)				
(a) In wrists or fingers	0.415	0.534	0.354	0.720
(b) In elbows or forearms	0.493	0.327	0.102	0.806
(c) In neck	0.003**	<0.001**	0.722	0.278
(d) In shoulders	0.275	0.058	0.344	0.139
(e) In hip and lower back	0.231	0.131	0.757	0.073
(f) In feet	0.270	0.598	0.256	0.736
Q16 Mental symptoms (respondents with pretty often or more symptoms and without)				
(a) Sleeping disorders/disturbances	0.115	0.019**	0.509	0.085
(b) Depression	0.001**	<0.001**	0.176	0.076
(c) Exhaustion at work	<0.001**	<0.001**	<0.001**	<0.001**
(d) Substance addiction	0.002**	0.059	0.003**	0.002**
(e) Anxiety	<0.001**	<0.001**	0.033**	0.014**
(f) Fear situations	<0.001**	0.002**	0.033**	0.113

** Significant at $p < 0.05$.

3.3. Logistic regression models

We combined questions 18, 19, 20 and 21 to a new dummy variable (accident/close call situation at leisure/work in which the mobile phone had a partial effect, during the last 12 months, yes, no). Next, we generated different logistic regression models, in which covariates were, e.g., demographic factors (age, gender, marital status, education, occupation, mother tongue and home county), work situation (at work yes, no), use of the mobile phones at work or at leisure and physical or psychological symptoms. Then, from questions (13 and 16) of the symptoms we also made new dummy variables so that the answers 'sometimes', 'pretty often', 'often' and 'very often' were 1 and other answers were 0.

The best model (model A) included age, the work situation and new dummy variables from symptoms sleeping disorders/disturbances (yes/no) and an ache, pain or numbness in feet (yes/no) and four dummy variables from education (vocational school, matriculation, vocational high school, vocational high school). The model B was otherwise similar as model A, but it not included an ache, pain or numbness in feet and the education was categorical covariates (1 = vocational school, 2 = matriculation, 3 = vocational high school, 4 = vocational high school, 5 = university). It was not possible to make logistic regression models from the separate questions 18, 19, 20 and 21, because the amount of yes answers was too little and the correct percentage was too small.

In the model A the percentage corrects were: 86.3% (correctly predicted no answers) and 50.3% (correctly predicted yes answers). The overall percentage was 74.5%. In the Hosmer and Lemeshow test the significance was 0.056, so the model fits fairly well. In the model B the percentage corrects were: 86.9% (correctly predicted no answers) and 49.4% (correctly predicted yes answers). The overall percentage was 74.7%. In the Hosmer and Lemeshow test the significance was 0.876, so the model fits well.

Table 3 shows the results of the logistic regression analysis with model A and Table 4 shows the results of the logistic regression analysis with the model B. The significance is shown $p < 0.05$ (** = significant). In model A (Table 3) the age, the work situation (yes/no) and the dummy variables from symptoms sleeping disorders/disturbances (yes/no) and an ache, pain or numbness in feet (yes/no) has an association with accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. The three dummy variables from education (vocational school, matriculation, vocational high school, yes, no) did not have associations with the accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In the tables B is regression coefficient, S.E. is standard error, Wald is Wald chi-square value, df is degrees of freedom and Sig. is 2-tailed *p*-value. The regression coefficient (B) of the age was −0.021 (Table 3). The value is so small that age is not of operational significance. The regression coefficient (B) of the factor 'at work' was −1.877. So the respondents in working life had more association to the accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In addition, if respondents had sleeping disorders/disturbances ($B = 0.197$) or an ache, pain or numbness in feet ($B = 0.193$), the amounts of the accidents or close call situations little increased.

In model B (Table 4) the age, the work situation and sleeping disorders/disturbances has an association to accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In addition, comprehensive school and vocational school were associated with accidents or close call situations at work or at leisure. The regression coefficient (B) of the age was −0.019 (Table 4). In model B the value is also so small that age is not of operational significance.

The regression coefficient (B) of comprehensive school was −0.524 and of vocational school was −0.297 (Table 4), so if the respondents chose another category of education they had little more accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In both models the work situation was associated with the accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In these models the working respondents had more the accidents or close call situations.

4. Discussion

4.1. Evaluation of the amounts of accidents and close call situations

In this study respondents were asked about accident/accidents or close call situation/situations, in which the mobile phone had a partial effect. Altogether 950 (16.1%) of persons had an accident or close call situation at leisure and 259 (5.2%) had accidents or close call situations at work, in which the mobile phone had a partial effect (Table 1). In the before mentioned amounts, there can also

Table 3
The results of logistic regression model A from dummy variable (accident/close call situation at leisure/work in which the mobile phone had a partial effect, during the last 12 months), from questions 18–21.

Variable	*B*	S.E.	Wald	df	Sig.
Age	−0.021	0.002	73.919	1	<0.001**
At work	−1.877	0.066	800.526	1	<0.001**
Sleeping disorders/disturbances	0.197	0.063	9.620	1	0.002**
Education; vocational school	−0.020	0.081	0.058	1	0.810
Education; matriculation	0.036	0.112	0.103	1	0.748
Education; vocational high school	0.084	0.079	1.137	1	0.286
Ache, pain or numbness in feet	0.193	0.064	8.917	1	0.003**
Constant	1.167	0.137	73.061	1	<0.001**

B = regression coefficient, S.E. = standard error, Wald = Wald chi-square value, df = degrees of freedom, Sig. = 2-tailed *p*-value.
** Significant at $p < 0.05$.

be cases, where the same respondent had an accident and close call situation. These cases were counted twice.

In 2010 there were a total of 6072 road traffic accidents involving personal injury in Finland and 272 people were killed in them (Statistics Finland, 2011). Based on the results of Transport Canada's September 2006 survey of seat belt use in rural areas of the country, an estimated 2.8% (±0.2%) of drivers were using a cell phone (Transport Canada, 2007) and the National Highway Transportation Safety Administration estimated that 8% of drivers on the road at any given daylight moment are using their cell phone (Glassbrenner, 2005). According to Eby et al. (2006), driver handheld cellular phone use has more than doubled between 2001 and 2005 from 2.7% to 5.8%. In our data, the quite many respondents reported accidents or close call situations in which a mobile phone had had a partial effect. It is possible that drivers in Finland use mobile phones more than in other countries. However, we only asked about accident/accidents or close call situation/situations, in which the mobile phone had a partial effect. We did not ask how many respondents generally used a mobile phone when they drove cars.

4.2. Evaluation of results using a Mann–Whitney U-test

In the comparison between the men's and women's groups, the men's group had more a close call situations at leisure in which the mobile phone had a partial effect and accidents or close call situations at work in which the mobile phone had a partial effect than the women's group. In addition, in comparison between different ages groups (under 30/45 years old and those over 30/45 years old), the younger respondents had more close call situations and accidents in which a mobile phone had a partial effect.

According to the National Public Health Institute (2006) in Finland domestic and leisure time accidents were 201.1 cases per 1000 persons in age group of 25–34, 134.3 cases per 1000 persons in age group of 35–44, 125.0 cases per 1000 persons in age group of 25–34 and 94.9 cases per 1000 persons in age group of 45–54. In our data the regression coefficient (B) of the age was −0.021 (Table 2), so the lower age had more association to the accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. So the results of the National Public Health Institute (2006) supported our results. The other studies (Davies et al., 2003; Glendon et al., 2006) had also observed that age and gender generally influenced the risks of accidents.

In general, respondents who self-reported mental symptoms pretty often or more had more close call situations at leisure or at work in which the mobile phone had a partial effect than respondents without mental symptoms. Respondents who had exhaustion at work, substance addiction and anxiety had more close situations at leisure and at work in which the mobile phone had a partial effect than respondents without those symptoms. However, people with sleeping disorders/disturbances pretty often or more only had more close call situations at leisure in which the mobile phone had a partial effect than people without these symptoms. It is difficult to find an explanation for these findings, but it is perhaps because of the effect of anxiety and fatigue on the attention paid by the respondent.

Respondents who self-reported physical symptoms pretty often or more did not have more close call situations or accidents at leisure or work in which the mobile phone had a partial effect than respondents without those symptoms. Only respondents who had pretty often or more experienced pain, numbness or aches in the neck reported more accidents or close call situation at leisure in which the mobile phone had a partial effect (questions 18 and 19) than other respondents. The neck problems can perhaps influence the driving skills. We reported in our earlier article that experienced pain, numbness or aches in the neck had an association with mental symptoms (Korpinen et al., 2009). Therefore, it is possible

Table 4
The results of logistic regression model B from dummy variable (accident/close call situation at leisure/work in which the mobile phone had a partial effect, during the last 12 months), from questions 18–21.

Variable	*B*	S.E.	Wald	df	Sig.
Age	−0.019	0.002	59.897	1	<0.001**
At work	−1.948	0.068	810.830	1	<0.001**
Sleeping disorders/disturbances	0.228	0.063	13.172	1	<0.001**
Education			19.030	4	0.001**
Education; comprehensive school	−0.478	0.114	17.762	1	<0.001**
Education; matriculation	−0.212	0.127	2.808	1	0.094
Education; vocational school	−0.261	0.100	6.757	1	0.009**
Education; vocational high school	−0.171	0.097	3.073	1	0.080
Constant	1.483	0.147	101.740	1	<0.001**

B = regression coefficient, S.E. = standard error, Wald = Wald chi-square value, df = degrees of freedom, Sig. = 2-tailed *p*-value.
** Significant at $p < 0.05$.

that the same people who had mental symptoms also had physical symptoms in the neck.

4.3. Evaluation of the results using logistic regression models

In statistical analysis, the percentage correct has been used to determine the quality of the logistic regression models. This is a tricky area and it is important to take it into account when analyzing our results. For most respondents there is no accident. Thus a high correct prediction for a no answer can be expected, even from a very poor model. For example, if the model only produced one answer all the time, and that answer was no, the model would predict a correct answer for no 100% of the time, but 0% for yes. Therefore, the model's quality should depend on the percentage correct for yes. The results show the correct prediction is for only about 50%.

In the models A and B the age, work situation, symptoms sleeping disorders/disturbances and an ache, pain or numbness in feet had an association with accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. In our data there were so few accidents and close call situations that we could not make logistic regression models only from accidents or close call situations. Therefore we combined questions 18, 19, 20 and 21.

In models A and B the regression coefficient (B) of the age was so small that age is not of operational significance. However, we found that if the respondents had sleeping disorders/disturbances or an ache, pain or numbness in the feet, the amounts of the accidents or close call situations increased. Others studies have indicated, that poor sleep quality had an association with an increased risk of occupational accidents (Ribet and Derriennic, 1999; Roth and Roehrs, 2003; Nakata et al., 2004; Hope et al., 2010). Therefore, our results that the sleeping disorders/disturbances were associated with the accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, are believable. However, it is possible that sleeping disorders/disturbances have only associated with the accidents or close call situations at work or at leisure and the mobile phone was not an important factor. In our data, we have only accidents and close call situations in which a mobile phone had a partial effect. In the future, it is perhaps possible to further study this topic. It is easy to understand, that an ache, pain or numbness in the feet had an associated with the accidents or close call situations in which the mobile phone had a partial effect, because the respondents or some of them perhaps had the accidents or close call situations with driving the car. The problems of feet can influence the skill of the driving.

In the model B education; comprehensive school and vocational school associated with accidents or close call situations at work or at leisure. However, we did not find an association between occupation and accidents or close call situations at work or at leisure in which the mobile phone had a partial effect, during the last 12 months. It is possible, that education had an association with accidents or close call situations, but based on our data it is difficult to explain more about the association.

Essentially, we found that: (1) men tend to have more close calls and accidents while on a mobile phone, (2) younger people tend to have more accidents and close calls while on a mobile phone, but it does not appear to be large enough to warrant intervention, (3) employed people tend to have more problems with mobile phone usage and accidents/close calls, and (4) there was a slight increase in mobile-phone-related accidents/close calls if the respondent also reported sleep disturbances and minor aches and pains.

In practice, nowadays many workers also use mobile phone when driving cars. So the risk of accidents or close call situations, in which a mobile phone had a partial effect, e.g., caused the situation, may be higher because there are so many mobile phones. It is possible that the driver is concentrating on the call so much that he or she does not notice what is happening on the road. In addition, workers can have such important tasks and be so busy that they have to make calls when they are driving and then make mistakes in the work tasks and the driving. It is difficult to perform many tasks at same time. In the comparison of the different groups based on gender, age, mental symptoms (e.g. exhaustion at work, substance addiction, anxiety or fear situations pretty often or more) and an ache, pain or numbness in the neck or feet there were significant differences in the answers to the questions about accidents or close call situations.

Based on our results, it is difficult to make strong recommendations for prevention or mitigation strategies, but we have some suggestions. For risk management on road safety, it is important to develop more driver training and bans on driving in certain situations (e.g., driver with pain or while tired or exhausted). Road safety has been improved, but traffic density has also been increased. Pedestrian safety and road maintenance, and the simultaneous use of mobile phones, can be risks that should be managed. Use of mobile phones at any kind of work scatters concentration. In the future, it would be important to take into account and study how symptoms can increase the risk of accidents or close call situations in which a mobile phone has a partial effect. This point of view is also valid in many other occasions, not only in traffic.

4.4. Evaluation of methods

The population was 15,000 Finns and the amount of responses was 6121, which is quite large. It is quite easy to make statistical analyses because the number of responses was so high. However non-respondents can have more accidents or close call situations than respondents. In this study only the questionnaire was used. Self-reported data are not very good for examining how large a risk cell phone use is. The responses are most likely to be biased. Furthermore, people involved in fatal accidents had no chance to fill out the questionnaire. When using the questionnaire we cannot get as much information as we can by doing interviews. Respondents may understand questions and words in different ways. In general, when using a questionnaire, the population can be larger than when conducting interviews. The use of a questionnaire also included good points. It is possible to get answers from many respondents, and the interviewer can influence the respondents. With a questionnaire, it is possible to use different statistical methods and to find associations with different questions better than when using limited data from an interview.

Different types of biases also occurred in the study. The questionnaire and questions can relate to participants so that only the active persons sent the questionnaire back and opinions can change quite quickly as the technology develops. All participants do not understand the questions in the same way. The questionnaire did not include all possible questions. The questions on accidents and close call situations included two parts. Part 1: have you had any accidents or close call situations, in which the mobile phone had a partial effect, during the last 12 months? Part 2: How?, (a) disturbed concentration while moving, (b) disturbed concentration while driving, (c) disturbed observing of the environment, (d) caused the situation, (e) other. The question with two points or levels were perhaps quite difficult for respondents, because quite many answered first that they had no accidents or close call situations, but in the next level they answered that in the accident or close call situations the mobile phone had a partial effect. For the statistical analyses we chose only the cases, where a respondent had had an accident/accidents or a close call situation/situations, in which the mobile phone had a partial effect, during the last 12 months.

The questionnaire included only questions on accidents or close call situations in which the mobile phone had a partial effect. Also,

some other functions of passengers can cause similar distractions as usage of mobile phones, namely cognitive (from conversing), visual (if the driver turns to look at a passenger), auditory (from listening to a conversation) and even manual (for example, a driver passing a drink to a child) (McEvoy et al., 2005, 2007). Our questionnaire did not include questions about these other functions, which was one weakness of the questionnaire.

In the study of Andersen and Mikkelsen (2008) the aim was to validate the accuracy of recalling work-related injuries in a questionnaire (retrospective self-reports 1 month back) compared with prospective diary injury records. Their results show that retrospective self-reports of injuries are considerably under-reported compared to daily reports. In our study the time period was during the last 12 months in the questions, so respondents possibly did not remember all accident and close call situations.

5. Conclusion

It can be stated that 13.7% of all responses had close call situations and 2.4% had accidents at leisure, in which the mobile phone had a partial effect, and at work amounts were 4.5% and 0.4% respectively, during the last 12 months. To conclude: (1) men tend to have more close calls and accidents while on a mobile phone; (2) younger people tend to have more accidents and close calls while on a mobile phone, but it does not appear to be large enough to warrant intervention, (3) employed people tend to have more problems with mobile phone usage and accidents/close calls, and (4) there was a slight increase in cell-phone-related accidents/close calls if the respondent also reported sleep disturbances and minor aches and pains. In the future, it would be important to take into account how physical or mental symptoms can increase the risk of accidents or close call situations in which a mobile phone has a partial effect. This can also be a good research area on different occasions.

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